

Speed & Velocity

1. Sally is running with a constant speed of 6 m/s. How long will it take her to run 100 meters?

$$v = \frac{d}{t} \quad 6 = \frac{100}{t} \quad \boxed{t = 16.7 \text{ s}}$$

2. The earth is about 1.5×10^{11} m away from the sun. What is the average speed (in m/s) of the earth as it orbits around the sun in it's (nearly) circular orbit?

$$v = \frac{d}{t} = \frac{2\pi(1.5 \times 10^{11})}{(365)(24)(3600)} = \boxed{29,900 \text{ m/s}}$$

3. You are standing at the edge of a large field. At the opposite end of the field is a huge building. You yell at the building, and hear an echo 2.5 seconds later. If the speed of sound is 340 m/s, how far away from the building are you?

Y $\xrightarrow{\text{---}} \rightarrow$ total time = 2.5 sec.

$$v = \frac{d}{t}$$

$$\therefore 1 \text{ way} = 1.25 \text{ s}$$

$$340 = \frac{d}{1.25} \quad \boxed{d = 425 \text{ m}}$$

4. Sharon walks 20 meters down a hall with a constant speed of 2 m/s. Then she walks backwards 20 meters down the hall, this time with a constant speed of 4 m/s.

- a. What was her average speed for the whole trip?

$$\text{Speed} = \frac{\text{distance}}{\text{time}} = \frac{20 + 20}{t_1 + t_2} \rightarrow \frac{40}{15} = \boxed{2.67 \text{ m/s}}$$

$$\textcircled{1} v = \frac{d}{t} \quad 2 = \frac{20}{t_1} \quad t_1 = 10$$

$$\textcircled{2} v = \frac{d}{t} \quad 4 = \frac{20}{t_2} \quad t_2 = 5$$

- b. What was her average velocity for the whole trip?

$$\bar{v} = \frac{\Delta x}{t} = \frac{0}{15} = 0 \text{ m/s.}$$

(She ended at her starting point, so $\Delta x = 0$)

5. The position as a function of time for Deoxys is given by $x = -30t^2 + 240t + 100$. Standard SI units. (That means x is meters and t is seconds.)

- a. What is the initial velocity of Deoxys? (That means v at time 0.)

$$v = \frac{dx}{dt} = -60t + 240$$

$$v @ t=0 \rightarrow -60(0) + 240 = \boxed{240 \text{ m/s}}$$



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- b. When is Deoxys not moving?

$$v = -60t + 240$$

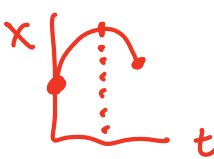
$$0 = -60t + 240$$

$$t = 4 \text{ s}$$

- c. For the first 6 seconds of the motion, what was the average velocity of Deoxys?

$$\bar{v} = \frac{\Delta x}{\Delta t} = \frac{x(6) - x(0)}{6} = \frac{460 - 100}{6} = 60 \text{ m/s}$$

- d. For the first 6 seconds of the motion, what was the average speed of Deoxys?

Notice: 

$$x = -30t^2 + 240t + 100$$

$$x(0) = 100 \quad x(6) = 460$$

$$x(4) = 580$$

$$\therefore d_1 = 580 - 100 = 480$$

$$d_2 = 580 - 460 = 120$$

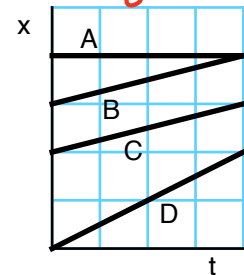
$$\text{So Speed} = \frac{480 + 120}{6} = 100 \text{ m/s}$$

6. The position as a function of time for four different objects are shown in the graph to the right.

- a. Which object is going the fastest? **D (steepest)**

- b. Which objects have the same speed? **B & C**

- c. Which object traveled the farthest? **D**

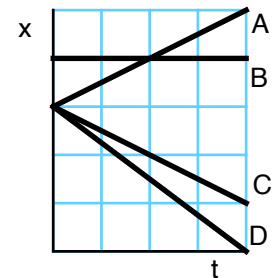


7. The position as a function of time for four different objects are shown in the graph to the right.

- a. Which object is going the fastest? **D**

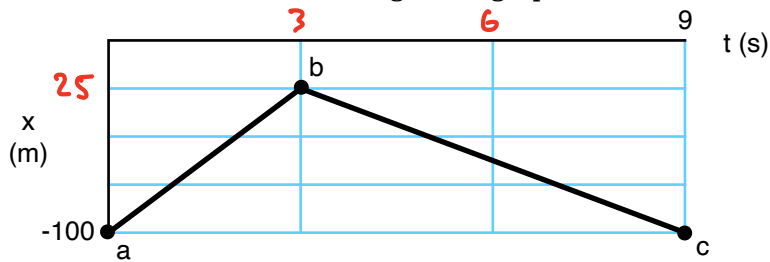
- b. Which objects have the same speed? **A & C**

- c. Which object traveled the farthest? **D**



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8. The position as a function of time for something in the graph below.



- a. From point *a* to *b*, what is the velocity and the speed?

$$\bar{v} = \frac{\Delta x}{t} = \frac{75}{3} = \boxed{25 \text{ m/s}} \quad \therefore \boxed{\text{speed} = 25 \text{ m/s}}$$

- b. From point *b* to *c*, what is the velocity and the speed?

$$\bar{v} = \frac{\Delta x}{t} = \frac{-75}{6} = \boxed{-12.5 \text{ m/s}} \quad \therefore \boxed{\text{speed} = +12.5 \text{ m/s}}$$

- c. From point *a* to *c*, what is the average velocity and the average speed?

$$\bar{v} = \frac{\Delta x}{t} = \frac{0}{9} = \boxed{0 \text{ m/s}} \quad \text{speed} = \frac{75 + 75}{9} = \boxed{16.7 \text{ m/s}}$$

Answers:

- 1) 16.7 s 2) 30,000 m/s 3) 425 m 4.a) 2.67 m/s b) 0 m/s 5. a) 240 m/s
 b) $t = 4$ c) 60 m/s d) 100 m/s 6. a) D b) B & C c) D 7. a) D
 b) A & C c) D 8. a) 25 m/s & 25 m/s b) -12.5 m/s & 12.5 m/s
 c) 0 m/s & 16.7 m/s